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ABSTRACT

Described are the results of a study in which the purposes were to: (1) develop a structure for teaching science utilizing a variety of techniques; (2) measure the performance resulting from the techniques; and (3) develop and evaluate an instrument using a specific technique for isolating other variables. The study allowed the students to select and utilize strategies suitable to their learning styles and the nonverbal instruments allowed for cultural freedom, and significant achievement. (Author/SA)

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The Analysis of a Tailor-Made Curriculum and its Impact Upon 5th and 6th Grade Minorities and Female Children

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Science is taught in elementary schools to bring about pupil growth in the cognitive, affective and psychomotor domains of knowledge. Beisenherntz (1972) stated that in most classrooms a major part of the school day is spent with language arts and mathematics being taught as mechanical states with little or no deviation in approach from day to day. Now science is slowly being integrated into that mode causing children to lose interest in the process of sciencing. Walker (1973) found that (1) the use of a variety of strategies employed in science teaching offered the participants procedural option of selecting and utilizing a specific strategy for his/her own learning style, (2) that the application of a "tailor-made" instructional sequence improved the abilities of minority and culturally different learners when direct, specific verbal instructions were stated in the language of their environment, (3) that the use of action verbs to articulate a specific objective proved effective in increasing the participant's ability to achieve distinguishing and manipulative tasks.

The curriculum consisted of instructional materials composed of mini-units. Each mini-unit contained less material per mini-unit than found within the entire curriculum. The curriculum was basically a two dimensional structure. One dimension was designed to describe what the participants were expected to learn resulting from direct contact with the curriculum itself, and the second dimension of the curriculum was concerned with the mini-unit organization. The content material for the curriculum was fixed and kept constant within the study.

The fixation of the content material allowed for the manipulation and use of different instructional strategies by the researcher.

Lavin (1969, p.38) says that if pupil intelligence alone were used to predict academic performances, the correlation methods usually assumes that the overall correlation is the same at all levels of intelligence. The investigator's concern was not that of a particular intelligence level but rather the acceptance of the participant at any level found within the existing classroom.

Purpose

The purpose of this study was: (1) to develop an embryonic structure for an experimental instructional technique in science whose design and philosophy encouraged the use of varied teaching techniques in meeting the need of a participating learner; (2) to measure any positive increase or fluctuation in performance resulting from the use of the technique, and; (3) to develop and evaluate the effectiveness of a non-verbal instrument which could be used to assess growth resulting from the use of particular instructional techniques while isolating other variables.

The formal research problem was:

Fifth and sixth grade students who receive instruction utilizing a holistic approach to the teaching of magnetic material and magnetic fields, using instructional television and other media as teaching devices, will score higher on a post-test within a five week period than on a pre-test given at the inception of the unit on magnetism using the same instrument for repeated measures during the study.

The hypothesis tested forsake of this report are listed in the following null form:

Ho_1: There will be no mean improvement between the pre- and post-test in the participants' ability to perform distinguishing and manipulation task as measured by the instrument constructed for this experimental study.

Ho_2: There will be no mean improvement in achievement per class, between the pre- and post-test, and will not represent 80 per cent of the participants, as evidenced by the instrument constructed for the experimental study.

Ho_3: There will be no difference in improvement of the three classes on each measurement M_1-----M_7 on the experimental study.

Ho_4: There is no correlation between the final scores on reading skills, and the final scores on problem-solving skills as determined by the Iowa Test of Basic Skills.

Ho_5: There is no correlation between the final scores on language usage skills and concept developing skills as determined by the Iowa Test of Basic Skills.

The tailor made curriculum consisted of selected electrical and magnetic principles designed especially for the audience of the study.

Need for the Study

The environment in which learners are placed plays an important role in the amount of measurable learning that occurs.

Persons responsible for this environment can realize maximum growth from the learners by providing the proper atmosphere while facilitating the necessary structure and equipment for that growth.

Facilitations can help learners use knowledge gained through meaningful experience rather than merely having them compile facts of sciences.

Butts (1965) supports the notion that the role of the facilitator can provide the desire for elementary science learners to search for basic principles and generalize from those principles. Hough (1966 p.97) also produces evidence which shows that the facilitative procedure in any instructional process maybe regarded as one which allows for the meeting of individual needs

more so than any other generally accepted procedure. However, a learning environment developed on this procedure must consider conditions such as (a) selecting, organizing the content and stating the objectives of instruction as observable participant behavior; (b) making and implementing instructional decision; (c) creating devices for measuring participants achievement; and (d) evaluating the appropriateness of objectives, the effectiveness of instruction and the validity of measuring techniques. Cognitive achievement in culturally different children have been, for the most part, almost denied due to the apparent inability of those learners. to interpret the design of the language and symbolism of standardized material. These designs and symbolism for the most part possess main qualifications that are unspoken and vague however clearly understood and recognized only by those learners who possess certain abilities and particular cultural makeup.

Little attention has been devoted to the use of alternative testing techniques for assessing the cognitive growth of culturally different children. The use of pictorial and other non verbal stimuli as cues have limited history in consideration for indepth utilization as the primary evaluation instrument in measuring the cognition of urban learners. (Miller-cited in Fleming 1980 p.236)

The appraisal of the effect of pictorial stimuli on learning is supported in that visual cues, realism cues and relevant cues from pictures tend not only to reflect reality but may selectively present and withold many varieties of cues which may (Fleming 1980 p.236) be relevant and irrelevant to any learning situation. More over some may be salient (Lumsdaine-cited in Fleming 1980 p.236) others obscure, some high fidelity to reality (Gibson-cited in Fleming 1980 p.236) others low.

The effects of a pictorial cue tend to provide the basis for such diversification as attention, recognition, memory, concept formation, attitude change, as well as interacting with learner characteristics (Fleming, 1980--p. 236).

Summary of Related Research

The development of a fundamental curriculum for this population of learners, the objectives of the study and the design of the evaluation instrument were all predicated upon the following assumptions:

1. Instructional material presented in parts of a total sequence will enhance the desired outcome of the study.
2. Repeated measurement over time will show a significant growth in performance if the learner knows exactly what is expected of them.
3. Interest in subject matter content will escalate when the facilitation allows for a variety of media and personal interaction of the participants of the study with the material provided.
4. That the selection of the curriculum, media and instructional strategies will be adequate for the participants of this study.
5. That the time limit of five weeks will be sufficient to accomplish the 80/80 prediction of the study.
6. That a non-verbal instrument is capable of effectively evaluating the progress of the participant of this study.
7. That cultural freedom will be evidenced by use of the non-verbal instrument and achievement will be significant.

Basic research in most of these areas provides adequate support for the assumptions made.

During the last decade significant strides have been made by researchers in an attempt to use specific teaching skills and strategies with students. Chief among those researchers are Hall, et.al. (1970), Lockwood (1971), Neujahr (1971), Stuchins (1972), and Conrad (1970), all of whom have provided some evidence that the use of teaching skills and instructional strategies tended to significantly affect student achievement.

The need for change in the ability to evaluate individual performances is supported in the literature by researchers such as Jensen (1968), Codwell (1969), Johnston (1969), Salomon and McDonald (1969), Bedics and Webber (1971), and Evans (1972).

The ability of media methodology and its effectiveness to produce change in select group behavior has been studied by researchers such as Adair and Kyles (1969), Chavers, et.al. (1970), Lippe (1971), Brantley (1970), and Fensternmacker (1972). These researchers all agree that media methodology when used with a particular audience yielded a significant difference due to application. Others have concluded however that it does not significantly change things.

Pictorial stimuli evaluations have been embraced by Dwyer (1970), Rohwer and Harris (1975), Levin, et.al. (1976), and Standing (1971).

All researchers concluded that the untapped usefulness of this type of evaluation process still provide a wealth of responses from learners which may not be assessable through other evaluation techniques.

Methodology and Design

This study used a quasi-experimental longitudinal or time series design. The data collected in the study was interpreted by use of the following statistical techniques for assessing the achievement of participants exposed to varied teaching techniques applied during the study, which use a one group pre- and post-test design on the experimental group. Below are the statistical tests:

1. The Analysis of Variances
2. Analysis of a Multivariate Linear Model
3. The Univariate and Multivariate Analysis of Variances, Covariances and Regression for Trend Analysis.

One of the requirements for the use of the longitudinal or time series design for research is a stated time limit within the hypotheses. This helps (Lavin, 1969, p.49) to support causal interpretation; however it does not establish them with certainty.

This study focused on the fifth and sixth grade levels with a particular instructional sequence and specified materials written and developed by the investigator.

Sixty-seven elementary children from one school were used in a large group setting from an inner city area.

The sample consisted of twenty-one fifth grade and forty-six sixth grade youngsters, all divided into three classes. The cultural identifications were six Mexican-Americans, one white American, and sixty Black Americans

who volunteered to participate in the study. Behavioral objectives constructed in an hierarchial form (Ramsey and Howe, 1969, p.27) attempts to control variables within an instructional sequence. The investigator attempted to control only two variables in this study. The first variable was the means of instruction. In this the investigator was concerned with the type of teaching strategy which could be used with the established curricula. This could only be determined after the investigator defined the type of behavior a participant was expected to exhibit upon the completion of the instructional sequence. The second variable was defined as the expected outcome of instruction. Thus the expected behaviors were established to be distinguishing and manipulative skills.

The processes used to engender these behaviors were (a) team teaching, (b) individualized instruction, (c) programmed instruction, and (d) laboratory-oriented instruction.

The media selection included instructional television, video-tape recording, electromagnetic tape recordings, and sixteen-millimeter films.

The cooperating teachers of the participants used were given in-service training involving the philosophy and utilization of the prepared materials to be used in the study. They were also taught to use the data-collecting device effectively and to interpret the conditional lines of force behaviors as found on the fifteen magnetic photograms used for testing the distinguishing and manipulative ability of each participant. The teachers became acquainted with the objectives of the study.

The teacher's aides also studied the objectives of the work book which had been written in terms of simple human behavioral performance. There were five observations made aside from the pre-test and post-test. There were developmental hierarchies created by the behavioral objectives.
This allowed the investigator to assess how far along each participant had moved within the curriculum aided by the behavior sequence.
There was constant observation in the form of a measurement test which helped the investigator to make such determination. During the overall investigation period, the participants were asked to suggest hypotheses for the behavior of the magnetic fields. The responses were often checked later by presenting the same test but in a different sequential order of the photograms which in a sense, served as a minimal revision of the same test. Although the sequential arrangements were altered, the contents of the test were not, so this allowed for the trend or longitudinal assessment by use of the same instrument.

Instrument

The evaluation instruments were composed of fifteen 8 X 10 high-glossed magnetic photograms produced by a photographic chemical process.
The lines of force captured on the magnetic photograms were produced by manipulating magnets beneath photographic paper sandwiched between two clear sheets of plexiglass. Iron filings were sprinkled on the plexiglass producing the lines of forces to be reproduced by the learner. Written questions were developed for the study to accompany a pictorial diagram

of randomly arranged particles. Symmetrically arranged particles drawings were also designed to explain magnetized and non-magnetized substances. Due to the non-existence of an available standardized test supporting the content and the objectives for the study members of the elementary science as well as those of the science and mathematics teaching center faculty who were familiar with the subject matter and competent in the field of magnetism, established the content validity of the test. Sax (1968, p. 167) claims that in the evaluation of achievement or performance, the test or evaluation of content is of extreme importance. The reliability of the test was established during two prototype studies conducted early on.

The stated objectives of the participant's workbook were also found to be representative measures of the test item intent. The pre-test, post-test and observational test used for measurement between the pre-test and post-test administration were determined to have high content validity as they were the same instrument.

It was decided that the interpretability of the time series design, even if presented in a somewhat antiquated device, (Campbell and Stanley, 1963, p. 37) be used throughout the investigation rather than shift to a new instrument.

Description of Data Collecting Procedures

The data were collected by use of a grid, having one vertical column designated for questions one through twenty.

Each individual column, except the participant member, was divided into two sub-columns: one was labeled "could"; the second was labeled "could not."

At the end of the grid at the farthest most horizontal end, there was space provided for the "raw score" and the "percentage of total response per participant."

Moving vertically down the column, the two sub-columns allowed for the determination of correct and incorrect responses and also provided the opportunity

for determining an item analysis of each response.

In collecting the data, the investigator or teacher simply observed the participant's performance and placed a check (✓) mark in the column labeled "could" if the participant responded correctly and a (X) in the column labeled "could not" if the particpant responded incorrectly. The investigation was conducted on the premise that the participant's response must be totally correct not partially correct. A partially correct response was considered as a totally incorrect response.

There was also a final Data Response Sheet which was composed of three 8 X 10 sheets with the following provisions on them. The first sheet provided a particular type action verb used for the post-test. This action verb was labeled "Distinguishing." The definition of an action verb provides an acceptable rationale for communicative purpcse.

The action verbs: (1) "naming," (2) "identifying," (3) "recognizing," (4) "describing," and (5) "ordering," all possess qualities which necessitated some form of discrimination requiring the utilization of the process of the distinguishing action verb; hence the Final Data Response Sheet was labeled "Distinguishing." The twenty spaces provided were used to write in verbal descriptions of the parallel non-verbal task required of the participants.

The "could" and "could not" column furnished a final growth record to all participants in the study based on the post-test performances.

The second sheet contained the actual physical arrangement of the magnets from which the magnetic photograms were made. Each position of the second sheet coincided with the verbal description found on the first sheet. This served as a permanent record of all fifteen tasks required of a participant in the study.

The third sheet contained four written questions plus a pictorial diagram of randomly arranged particles and, also, symmetrically arranged particles which were used to explain magnetized and unmagnetized substances.

The four written tasks could be read by participants or verbally stated to the participant by the observer.

A high glossed photogram was produced on each configuration. The participant was furnished with a photogram and provided the necessary time and equipment with which to work. Samples of this equipment included plexiglass, cardboard, iron filings, wood supports and magnets. This equipment was used by the participant to manipulate the set up until s/he reproduced on her/his setup the identical lines of forces seen on the photograms given him.

The observer, upon the completion of the task, then inspected the work and checked the appropriate column provided.

If participants did not quite understand all of the expectations of them they could question the observer without restriction.

However, they were required to perform their own task after clarification had been provided.

A final "Data Response Sheet" was compiled for each participant; and at the end of the study, they were given a sheet representing their performance in the study.

During the study a log was kept consisting of the aforementioned instrument used for collecting the data. The data of each observation were recorded at the time of the observation of each group of participants. A copy of these three sheets was given to the participants for the participant's own personal record, use and reference. Instruments are appended.

The analysis of the data collected during the experimental study was carried out by the utilization of a number of acceptable statistical treatments.

These treatments also clarified and supported those hypotheses of the study established in the beginning of this paper. The pre-test and post-test scores collected from the participants provided the data to which the statistical techniques were applied. Final scores furnished by the Iowa Test of Basic Skills also were used to statistically test the relationship among variables.

The test analysis of difference between pre-and post-test means was used to test hypotheses one, and two. The level of rejection of the null hypothesis was established to be .05.

A multivariate ANOVA for repeated measure designs with three individual classes and seven repeated measures was used to test the achievement on each measure of the classes. To establish a trend of growth, a trend analysis technique was applied.

Reading level skills and language usage skills were used as variables. These variables helped to provide the statistical evidence needed to reject or accept the stated null hypothesis of each variable.

Analysis of Data and Results

The content of this section includes the restatement of the null hypotheses discussed in this paper, the analysis of data collected, and a summary of the findings.

Each hypotheses is discussed individually and supportive evidence is contained in tables adjacent to the analysis of the data.

The class cell frequency for this study was determined by the list of student's names found in the classroom teacher's roll book. The number of names listed in each roll book was counted and added to the sum of the existing names to determine the frequency for the study. Class number one, a fifth-grade class labeled C_1, had a frequency of 21 participants. Class number two, the first of the two sixth-grade classes labeled C_2, had a frequency of 23 participants, and class number three, the second of the two sixth-grade classes labeled C_3, had a frequency of 23 participants.

The cell means in all cases were determined by acceptable statistical methods. Found within this analysis are various tables which have been formulated to show the results of the statistical treatment of the data collected during the experimental study.

TABLE 1.--Means and standard deviations for three classes on experimental study.

Classes		$\bar{X}$	SD
C_1	21	82.52	5.15
C_2	23	83.75	4.72
C_3	23	82.61	3.62

C_1> N=21; C_2> N=23; C_3> N=23.

In comparing the means for the three classes, class C_1, and class C_3, differ from the means of the total experimental group by a margin less than 0.28 for class C_1, 0.19 for class C_3 while class C_2 exceeded the means of the total group by a margin of 0.95.

The standard deviation of the experimental group was greater than the standard deviation on only one of the classes when individually analyzed. The cell means and standard deviation on seven measures showed a significant increase on the measurements M_1-----M_6. Constant increases in performances were shown in certain class groups, nearing the final measurement session, however regression in one measurement became evident.

TABLE 2.--Means and standard deviations for experimental group.

N	$\bar{X}$	SD
67	82.8	4.53

The cell means and standard deviation on seven measures for three classes of the pre- and post-test criteria provides the simplified form and clarity needed to highlight the descrepancies existing between the means and standard deviation of the pretest of the three classes and also show the increase in the values of the means and standard deviation in the post-test measures over time. (Table 3)

TABLE 3. --Cell means and standard deviation on seven measures for three classes of pre- and post test criteria.*

	M_1		M_2		M_3		M_4		M_5		M_6		M_7	
Classes	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
C_I	2.85	.65	4.80	1.43	8.80	1.99	12.7	1.75	15.7	1.60	17.9	1.02	16.4	1.03
C_2	2.00	.00	3.82	.576	5.26	.751	8.78	2.50	14.0	2.04	18.4	1.27	16.7	.963
C_3	.956	.208	4.39	1.37	6.21	2.13	8.60	3.04	12.5	2.46	17.7	1.04	16.5	.730

*C_1>N=21; C_2>N=23; C_3>N=23.

TABLE 4. --Means and standards deviation of pre- and post-measures for three classes on seven measures.*

	Distinguishing and Manipulation			
Classes	Pre-Test		Post Test	
	$\bar{X}$	SD	$\bar{X}$	SD
C_1	2.85	.65	16.4	1.03
C_2	2.00	.00	16.7	.93
C_3	.956	.208	16.5	.730

*C_1>N=21; C_2>N=23; C_3>N=23.

The significant difference for the stated hypothesis (HO_1 and HO_2) is provided in Table 5 using the pre- and post-test measures for the three classes. Treating the data with a multivariate analysis technique provided the evidence needed to reject the two hypotheses in their null form when the treatment

on repeated measures was applied. Moreover the use of the Univariate, F values along with the probability criteria support the rejection of HO_1 and HO_2. (Table 6)

TABLE 5.--Significant difference of pre- and post-means in distinguishing and manipulations on seven measures.*

Classes	Pre-Test $\bar{X}$	Post Test $\bar{X}$
C_1	2.85	16.4**
C_2	2.00	16.7**
C_3	.956	16.5**

*C_1>N=21; C_2>N=23; C_3>N=23.

**Significant at .01 level.

TABLE 6.--Univariate F values and criteria used from the multivariate analysis comparison for all participants.*

Sources	DF	F Value	P
M_1	--	--	--
M_2	64	16,669.87	.0001**
M_3	64	6,097.85	.0001**
M_4	64	1,952.15	.0001**
M_5	64	393.88	.0001**
M_6	64	83.92	.0001**
M_7	64	105.7473	.0001**

*Gain for Total Group from M_1---M_7 when N=67.

**Significant at .01 level.

The rejection of these two hypotheses support the notion that mean improvement over time between the pre- and post-test was adequate representation of the participant's ability to learn as measured by the nonverbal evaluation instrument. Moreover the contention that at least 80 percent of the content material would be accomplished by 80% of the participant due to the use of the instrument constructed was supported. The statistical treatment also certified that there would be an increase in the abilities of the participant to perform manipulation and distinguishing tasks. A multivariate analysis technique on different classes on seven measures provided the statistical findings from the data collected on the means of all repeated measures. The results of this technique supplied the evidence needed to reject the hypothesis claiming that there would be no difference in improvement between the three classes on each measurement M_1----M_7 during the experimental study. (Table 7) (HO_3)

TABLE 7. -Multivariate analysis of different classes on seven measures.

Source	DF	Likelihood Ratio	Chi-Square Approx.	P
Repeated measure	6	.0026	362.40	.0001**
Between classes	14	.0814	153.04	.0001**
Subjects within group	--	--	--	--
Repeated measures by group	12	.2075	96.71	.0001**
Interaction RS: Groups*	--	--	--	--

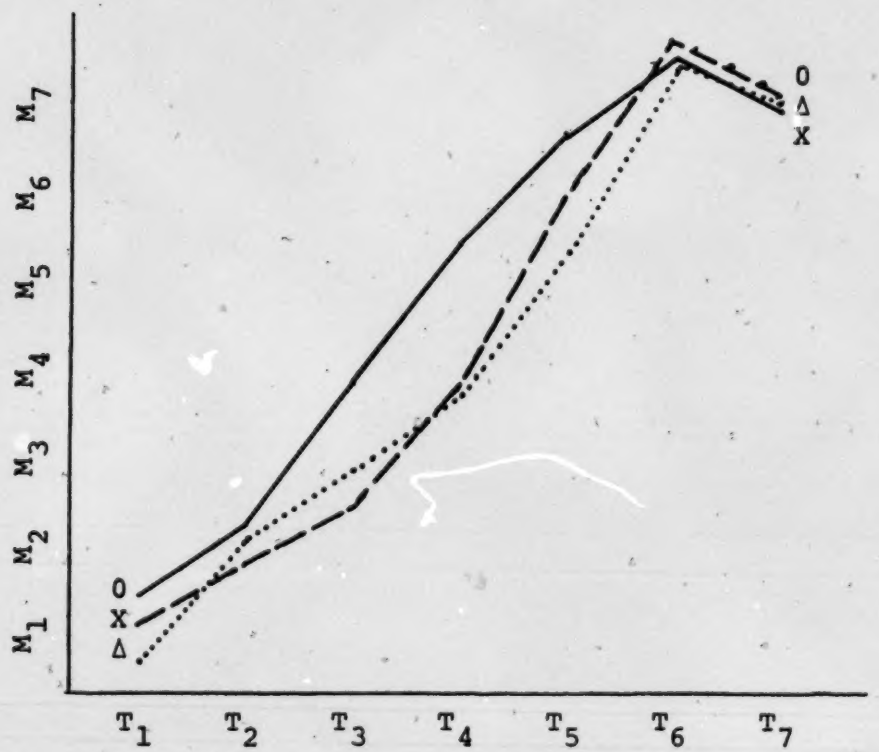
*RS: Groups=Repeated measures by subjects within groups.

**Significant at .01 level.

The rejection of this null hypothesis permits us to accept the fact that improvement did occur on each measurement from the pre-test M_1 to the post-test M_7. Furthermore, it provided sufficient evidence that there was interaction within groups. The level of significance criteria was p is less than .01. Figure 1 shows the trend of growth for the three groups. The means of the cell frequency were used as dependent variables, and the time interval was used as the independent variable.

Figure 1

	M_1	M_2	M_3	M_4	M_5	M_6	M_7
C_1	2.85	4.80	8.80	12.7	15.7	17.9	16.4
C_2	2.00	3.82	5.26	8.78	14.0	18.4	16.7
C_3	.956	4.39	6.21	8.60	12.5	17.7	16.5



C_1 = | 0 | Class 1

C_2 = | X | Class 2

C_3 = | Δ | Class 3

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Figure 1.--Mean class achievement per observation time.

Correlation Data on Specified Variables

This study attempted to determine if there was any relationship existing between given sets of variables. Specific variables were selected for this correlation procedure. These variables were chosen to determine if the language usage skills and the reading skills affected the participant's ability to solve problems and to comceptualize.

The scores used for this correlation were standardized scores taken from the Iowa Basic Test of Skills and the post-test of the experimental study. The correlational variables of interest were reading skills and problem solving skills, language usage skills and concept developing skills.

The statistical test r was provided by the use of the Pearson Product Moment Correlation Formula and the application of the Analysis of Variance Statistical Technique. The results of the correlation technique showed that the participant's language did not impede his/her ability to achieve significantly and increased the participant's ability to perform certain tasks more effectively. The correlation between reading skills and problem solving skills hypothesis was rejected. The r value between the two variables were shown to be .474. (HO_4) The correlation between language usage and concept skills hypothesis was also rejected. The r value between the two variables was shown to be .399. (HO_5) All correlations were significant at the probability criteria level of .05. (Table 8)

TABLE 8 --Analysis of variance Pearson Product moment correlation between final scores of variables taken from Iowa Basic Test of Skills and experimental posttest scores.

Var. No.				
9*	1.00000			
10	.51018	1.00000		
11	.37130	.47472	1.00000	
12	.39960	.36564	.44110	1.00000
	9	10	11	12

*These numbers identify the following variables: (9) concept formation skills, (10) problem-solving skills, (11) reading level skills, (12) language usage skills.

Table 9 provides information on the observations made on the three classes, dates of observations, total number of observations per class and class sizes. Moreover the total number of points accumulated by the three classes on each measurement is also shown.

The other two factors of interest in this table are the number of participants who took each test and the total number of possible points per class.

TABLE 9. --Observations by class.

		Observations							M	Class Size	P P	Total Possible
Classes	C_1, C_2, C_3 Dates	M_1	M_2	M_3	M_4	M_5	M_6	M_7**				
C_1	CR	54	101	185	268	331	377	346				420
	Dates	4/24/73	5/1/73	5/8/73	5/15/73	5/22/73	5/29/73	6/7/73	7	21	21	
C_2	CR	48	92	126	210	270	423	400				460
	Dates	4/24/73	5/1/73	5/8/73	5/15/73	5/22/73	5/29/73	6/7/73	7	23	23	
C_3	CR	20	101	133	198	288	414	349				460
	Dates	4/24/73	5/1/73	5/8/73	5/15/73	5/22/73	5/29/73	6/7/73	7	23	23	
Total Scores		122	294	444	678	889	1,234	1,095	8	67	67	1,340

*M_1 denotes pretest (M_7**) denotes posttest. M denotes total number of measurement per class. PP denotes total number of participant taking all measurements per class; 420, 460, 460, denotes the total possible number correct per class per measurement.

Table 10 summarizes the data analysis for each hypothesis tested. All five hypotheses are restated, listing the statistical model used to analyze each hypothesis given and the results of this analysis is based upon the .05 criteria level used to test for significance.

Table 10.--Summary of data analysis for each hypothesis tested.

	Statement of Hypothesis	Model Used for Analyzing Data	Results Based Upon .05 Level
HO_1	There will be no mean improvement between the pre- and post-test in the participants' ability to perform distinguishing and manipulation tasks as measured by the instrument constructed for the holistic approach.	Multivariate analysis of linear analysis	A significant difference
HO_2	There will be no mean improvement in achievement per class between the pre- and post-test and will not represent 80 percent of the content material being successfully mastered by 80 percent of the participants, as evidenced by the instrument constructed for the holistic approach.	Multivariate analysis of linear trend	A significant difference
HO_3	There will be no difference in improvement between the three classes on each measurement M_1----M_7, on the experimental study.	Multivariate analysis of linear trend	A significant difference
HO_4	There is no correlation between the final scores on reading skills and the final scores on concept skills as determined by the Iowa Test of Basic Skills.	Analysis of Variance	A significant difference
HO_5	There is no correlation between the final scores on language skills and problem-solving skills as determined by the Iowa Test of Basic Skills.	Analysis of Variance	A significant difference

The means of the raw data collected in the study were used to construct a trend of academic achievement between the three classes. The use of a time series study assumes a linear progression during an instructional sequence. To decide whether linear progression occurred and to judge the significance of this time series study, a statistical treatment was applied involving the univariate and multivariate analysis of variance, co-variance and regression.

A trend run for repeated measures was made to determine if the experimental study showed a linear trend.

The criteria used for establishing significance was p is less than .0001. This study proved significant in the first four variables; however, the linear variable was the only variable initially sought by the investigator.

TABLE 11. --F-ratio for multivariate test of equality of mean vector = 4919.63 D.F. = 6. and 59.000 P less than .0001.

Variable	Hypothesis MS	Univariate F	P less Than .0001
1. Linear	9474.53	6053.33	.0001**
2. Quadratic	214.60	61.03	.0001**
3. Cubic Trend	449.77	200.12	.0001**
4. 4 Power	67.9366	74.1390	.0001**
5. 5 Power	3.3831	2.0828	.1539

**Significant at $P < .0001$.

Additional evidence of the claim that 80% of the participants did receive 80% of the material was calculated by taking the percentage of all raw scores. A statistical significance was gained by use of a two cell chi-square calculation. (Tables 12 and 13)

Table 12. --Percentages based on post-test achievement raw scores.

Percentage	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	Total participants
Distribution	---	---	---	1	6	21	33	4	2	----	67
80% and Above	----	---	---	---	---	21	33	4	2	----	60

*Sixty participants received 80% of the material and represent 89.4% of the participants of the study.

Table 13.--Two cell Chi-square calculation.

Source	DF	F-Value	P
Chi-Square	1	10.827	.001

*Significant at .05 level

F = 42.88

Assuming Equal Frequency under the Null Ho.*

* J.P. Guilford - Fundamental Statistics in Psychology and Education. McGraw Hill Company, New York Fourth Edition, 1965, pp. 235-236.

SUMMARY AND CONCLUSIONS

Overview

Found in this section is a brief summary of the experiemental study specifying the objectives of the study, the experimental curriculum, and hypothesis. The findings used to draw conclusions about this study were provided by the data collected and statistically analyzed early on in the paper.

Implications for future investigators, elementary science teachers and curricula developers are also found within this section. The final section of this paper includes the following discussions:

1. The affects of the experimental study upon the participants used in the study.
2. The recommendations for the implementation of this study and specific areas of the study suitable for future investigation.

Summary

The objectives of this study were:

1. To determine the effects of an experimental teaching strategy on fifth and sixth grade learners of culturally different children.
2. To determine the effects of different levels of language usage on the cognitive abilities of learners to perform specific tasks, when stated to them in simple human behavioral terms. Those behavioral terms were stated to them in the language of their environment.
3. To determine if the reading level of a participant of the study affected the participant's ability to perform specific tasks, when stated to them in simple behavioral terms.

4. To determine if the use of a non-verbal instrument for evaluating the achievement of learners could be used with culturally different children. This was done to determine if the participants of this study could achieve at a level of a predicted expected outcome using a specific instructional strategy. The mean achievement on the post test was compared to the mean achievement on the pretest to determine whether the participants in the study would show growth in their abilities to perform distinguishing and manipulating tasks.

These abilities were developed by use of curricula materials written and organized by the investigator.

Scope of the Curricula

The material found within the curricula focused on two specific areas--magnetic materials and magnetic fields.

The first area was concerned with materials that were affected by magnets and with other material whose properties were not affected by magnets. The development of reasons for the responses to a magnet were not as important as the description of what occurred when the phenomena were observed.

The second area involved magnetic fields. This concept was selected because it is not easily understood by most learners--especially learners of the fifth and sixth grade level. Extensive work was done in this area with the participants; the materials designed were used to help develop manipulative skills for creating magnetic patterns using iron filing and a series of magnets arranged in various configurations. The patterns thus created were made into photograms. The magnetic photograms were used to develop children's ability to distinguish between different magnetic patterns created by the manipulation of the magnets.

This helped participants develop skills needed to produce lines of forces unaided, and to match them with the lines of forces on the test instrument.

Sequence of the Curricula

The sequence of the curriculum materials was as follows:

Television Scripts

Television scripts were written and a video tape recording was made including the kinds of activities to be carried out in class by the participants individually or in groups. After viewing the video tape a teacher-directed follow-up was conducted. This was always done by the writer explaining and emphasizing the words, definitions, and processes presented by the video tape. At the close of the follow-up session, the members of the teaching team and their teaching aides helped to assemble apparatus, pass out materials, assign participants to groups and helped students interpret which objectives were to be used for each activity. The teachers also evaluated the children in terms of the lesson objectives of the activities. Initially the curricula writer had developed teacher background materials. Because there was no "scheduled" time for science lessons in the teacher's daily lesson plans prior to the inception of the study, the first attempt to use written materials with the teachers was very ineffective. The decision to verbally instruct the teachers on the order in which each session was to be conducted proved much more productive. This procedure was continued for the duration of the study.

Workbook

Workbooks were written and used in the study for each participant in conjunction with instructional television and video tape materials. The workbook was used to provide additional activities different from those viewed by participants on television. Activities found in

the workbook were written with specific behavioral objectives developed in a hierarchical sequence.

The participant had to complete activities accompanying lower order objectives which provided the prerequisites for objectives of higher order and a more demanding activity. Each objective was related to the materials presented by instructional television in that the activities in the workbook led to the desired outcome of the study. Moreover, after each formal presentation of materials, activities were taken in succession, providing the extensive practice needed to move from one activity to another.

There were eight activities, each having a set of objectives, materials list and operational instruction. For participants who did not wish to read the instructions for each activity in the workbook, audio tapes were provided. The audio tapes provided the participant another procedural option. He/she could receive instructions from the facilitator, read the workbook instructions, or listen to the tapes for directions. After each session with participants the teacher was briefed on the strategy for the extensive practice section provided. Practice activities usually occurred later in the day and a transfer activity was provided for the next day.

The following schedule represents the material and the general sequence in which major lessons were presented.

1. Pre-test or measurement one.
2. Video tape presentation on magnetic materials and follow-up. Reporduction of follow-up television demonstrations providing Chart I and Chart II for each child.
3. Large group laboratory sessions focusing on "eye-openers" 1-3.
4. Video tape presentation on magnetic fields with follow-up and large laboratory session focusing on "eye openers" four and five.

5. Test on measurement two and "eye opener" six--in class small groups.
6. Measurement three--film: Magnets for Beginners.
7. Measurement four with extensive practice in small groups.
8. Measurement five with extensive practice sessions in small groups--eye opener 8.
9. Measurement six with extensive practice session--eye opener 8.
10. Measurement seven--post-test--continued practice.

Summary

The sequencing of the printed and media curricula materials was done in such a way that the instructional television provided the nucleus needed to structure the workbooks, audio tapes, extensive practice sessions, and repeated measurements. These collectively formed the operational synthesis of the Holistic approach. The order was provided by the behavioral objectives of the workbook.

Conclusions

The conclusions for this study are predicated on the findings of this study. The descriptions of the conclusions found below seem justified.

1. The significant findings and the rejection of null hypothese (HO_1) one and (HO_2) two suggests that the strategies used for the Holistic Approach differed from techniques and philosophies used in conventional strategies.

   The difference in use of strategies provided in this study offered the participants of the study, procedural options of selecting and utilizing the strategies which were suitable for their learning styles.

Furthermore, the statistical proof of the abilities of the participants to execute tasks better after this instructional sequence had been applied provides the evidence that the cognitive abilities of culturally different children were enhanced and improved when given direct and specific verbal instructions in the language of their environment.

2. The significant proof of the statistical correlational treatment of hypothesis (HO_3) three, (HO_4) four, and (HO_5) five between reading levels, language usage, concept formation and problem-solving on the standardized test, provided conclusive evidence that the participants of the study possessed ability to conceptualize and solve problems. These abilities were validated by the experimental study. This validation was made possible by providing physical interaction with simulated representation of a phenomenological condition of magnetism. This further suggests that continuous interactions with material substances can be used to explain behaviors of theoretical entities by extensive practice and appropriate materials.
3. Findings provided by theses null hypotheses proved that there was no difference between abilities of reading level groups and language usage level groups to achieve on the post-test. This allowed the investigator to conclude that efforts to adjust to the environmental conditions were successful and the precision of diction did not hinder the quest for knowledge.

Implications from the Study

1. The participants demonstrated that the use of "standard" language and English did not offer any barriers to the abilities of the participants to achieve and satisfied the environmental language requirement of culturally different children.

This implies that achievement in this study was due to the interest, interpretation and the articulation generated by the action verbs written in terms of simply human performance for the participants. Moreover, the accomplishment of the objectives using action verbs proved effective and suggests that the participants did not have to "figure out" what was expected of them. Consequently the findings of this study suggest that students would benefit greatly from being told precisely what is expected of them and, when told what to do, they can do it.

2. The utilization of a non-verbal instrument for evaluation proved effective in this study. The participants showed favorable responses to an evaluation technique of this type. The challenges that it offered seemingly stimulated their mental activities as they were able to successfully test and verify their hypothesis.

It appears that an instrumention of evaluation that offered novelty promoted eagerness to learn. The utlization of additional instruments of this type in the future should prove challenging and exciting to most learners.

3. The anlaysis of the data collected statistically showed that by specifying a desirable type behavior, predicting an expected academic performance and using a variety of instructional strategies and accompanying media, participants performed favorably.

This suggests that in the attempt to engender a desired academic standard, teachers and researchers should identify and use only those variables that they can control.

4. The strategies, philosophy, and content specifications of this experimental study suggest that participants subjected to this experimental strategy and curricula achieved significantly. It appears that the usage of this design in other programs might prove effective in the learning process.

The Effects of the Experimental Study on Participants

The investigator was interested in the affective domain of the participants. To determine how the participants felt about the program organically, the participants were asked to write letters to the investigators expressing their feelings for the experimental study. From the letters returned, three words were used to express their feelings for the program in all written communication. They were "enjoyed very much," "enjoyed," and "liked." These three words were used to establish categorical groupings of all returns from the participants.

The following information expresses the status of the returns in terms of percentages, calculated from the total number of written returns received from the participants. Sixty-seven percent of the returns stated that they "enjoyed it very much;" twenty-two percent said they "enjoyed it;" and eleven percent exclaimed they "liked it." These expressions of feelings for the program, coupled with the achievement of the participants in the program suggests that the affective domain of the participants was enhanced along with the cognitive domain and the psychomotor domain. This further suggests that this tailored-made curriculum was successful as an instructional strategy.

Recommendations

Based upon the findings of the experimental study, the following recommendations seem appropriate.

It is recommended that more longitudinal and time series studies be done with culturally different learners. This type of study provides continual measurement and does not focus on achievement at only one given time.

It is recommended that the use of behavioral objectives and action verbs become more evident in instructional sequences of this type. This supplies the student with the information needed telling him/her exactly what is expected of him/her when achievement is the expected outcome.

It is recommended that elementary class activities, investigations and curricula specification include the use of multi-media, multi-material and novel approaches to instruction. These provisions tend to engender the desire of a student to actively participate in an instructional sequence such as the experimental study.

It is further recommended that further research be done to implement this study focusing specifically on determining (a) why the differences occurred between classes, (b) in which classes the difference is found, and (c) how does it differ.

It is recommended that non-verbal evaluation materials be used for implementing conventional evaluation techniques and also be considered for use on all levels of instruction.

It is recommended that more novel consideration be given to the use of "standard" materials, curricula and strategies with culturally different groups until such time that all cultural groups have had access to most of the background experiences needed to cope in society. This is especially essential in a society such as ours which assumes that all things are available to all members of that society.

It is recommended that only variables that are controllable by the investigator, teacher and curricula developers are considered when an instructional sequence is designed.

It is recommended that investigative studies and classroom instructional processes encourage verbal or written feedback from learners on their actual feelings about the instructional strategy being used for their elementary science studies. Such suggestions to an investigator or instructor provides helpful insight into the facilitation of strategies suitable for most learning styles during an instructional sequence.

It is recommended that inservice preparation and/or training be furnished to elementary science teachers required and/or electing to work with culturally different groups. This training should stress the application of novel approaches to existing required academic endeavors, utilizing as much conventional hardware and software as possible/available.

It is recommended that a central figure or leader be used in a total design of the specific instrumentation of a curricula. This leader should have working knowledge of the instrumentation used in design and should be able to impart this knowledge to assisting team members.

The curricula itself should be multi-phasic and all available material used should involve physical interaction with the materials by the participating team members prior to pupil usage. The assigning of work and activities to each team member should depend upon strength and weaknesses of the supporting team assuming that the capabilities of team members will vary. Constant inservice training should be provided by the leader, for the assisting teaching team. The success of this instructional design will depend upon the planning and sensitivity of the central leader and cooperative efforts of the supporting team.

It is recommended that federal and state funding be provided to implement this approach at the national level. The funds furnished would be used to employ the services of consultants, purchase special equipment, conduct in-service training and provide mini-work shops for both central leaders and supportive team members.

It is recommended that special materials be furnished for culturally different groups to help develop the "coping" ability to handle already existing conventional materials.

Final Data Response Sheet

Name _____

Observation Date _____

Distinguishing

Directions: Given a magnetic photogram of each of the following magnetic fields as indicated by their magnetic lines of force, the participant will study the lines of forces; use the available equipment provided for him and reproduce the arrangements of the magnets by Distinguishing between attraction-attraction lines of force, the attraction-repulsion lines of force, the repulsion-repulsion lines of force, the lines of force created by the end of; a bar magnet, a round magnet and a horseshoe magnet.

	Responses	
	√Could	Could not/
1. One Bar Magnet		
2. Two Bar Magnets (N-S)		
3. Two Bar Magnets (N-N)		
4. Two Bar Magnets (N-Washer-)		
5. Two Bar Magnets (N-washer-N)		
6. One Bar Magnet Upright		
7. One Round Magnet Upright		
8. One Horseshoe Magnet Flat-side		
9. One Horseshoe Magnet Pole Upright		
10. One Bar Magnet N-Unmagnetized steel		
11. Two Bar Magnets At Right Angles-Centered		
12. Four Bar Magnets (N-S-N-S) at right angle		
13. Four Bar Magnets (N-N-N-N) at right angles		
14. Four Bar Magnets (N-N-N-S) at right angles		
15. Four Bar Magnets (N-N-S-S) at right angles		
16. Magnetic Reacting Pile-Non-Magnetic Reacting Pile		
17. Magnet Beneath Setup-Distinction Tasks		
18. Distinction Tasks of Strongest Part of Magnet		
19. Four Photograms Different Size Washers		
20. Diagrams: A-Non-magnetic "stuff", B-Magnetic "stuff"		

DATA COLLECTING INSTRUMENT

P.I.D.N*	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		Total Raw Score		Percent Total
	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	Could	Could Not	
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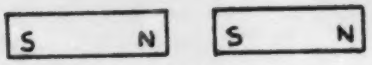
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20				

* Participant Identification Number

2)



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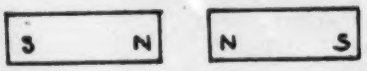

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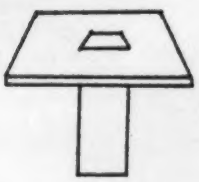
5)

6)



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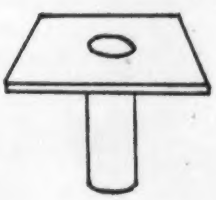

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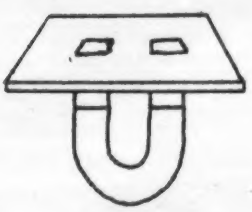
9)



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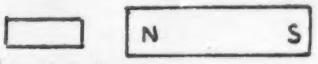
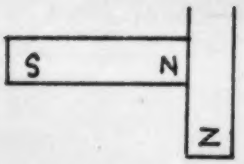


piece of steel



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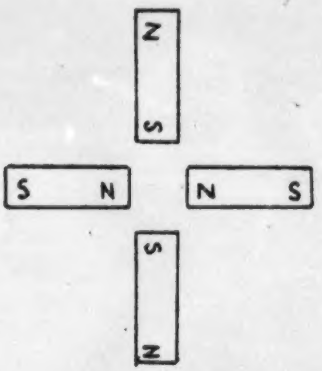

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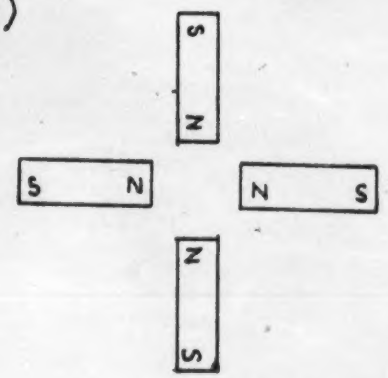

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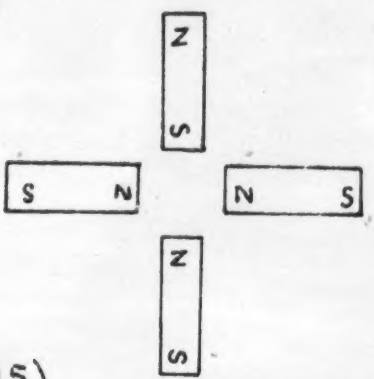

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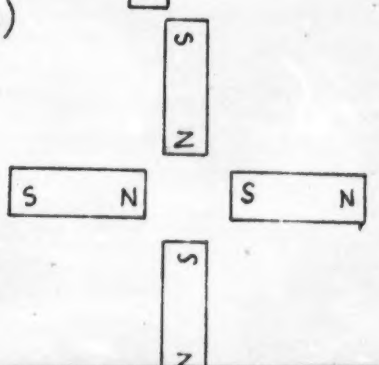


16. In this container there are two kinds of "stuff"
    1) Those which react to magnets
    2) Those which will not react to magnets

    Dump the "stuff" out on your table or desk top. Now make two heaps or piles of "stuff", by using your magnet to separate the "stuff". Then correctly place the two signs given to you for distinguishing each pile as either (1) magnetic reacting pile or (2) non-magnetic reacting pile.

17. With this set up identify the type magnet beneath the paper, now distinguish the type magnet used beneath the paper from the second magnet in front of you by sprinkling iron filings on the set up and observing its magnetic lines of force.

18. Using a round magnet, a container filled with washers using the follow up activity from the first telecast furnished you. Identify the strongest part of the magnet and distinguish between the parts by giving and acceptable name for each.

    Identification_____

    Distinction by names:

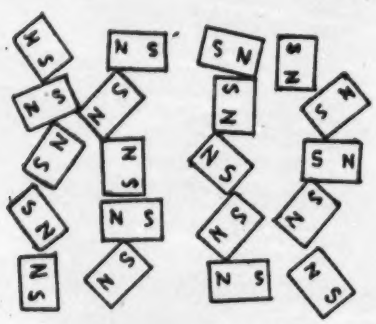
    1)_____

    2)_____

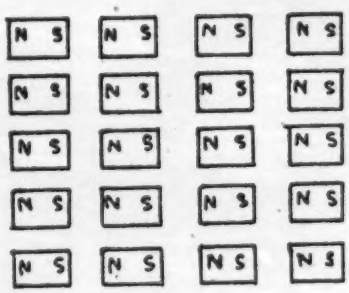
19. Take these 4 photograms, made with four different size washers and distinguish between them by arranging them in order of increasing size of washer. (Begin with the smallest washer first).

20. With the two diagrams below, distinguish between the diagram which represents a magnetic piece of "stuff" from a non-magnetic piece of "stuff" by pointing out the correct alphabet in the diagrams for magnetized "stuff" and unmagnetized "stuff".

A.



B.



art work by

Marcia Kohatynski

EXPERIMENTAL RAW DATA AND PERCENTAGE SCORE

PIDN*	RAW SCORES Pretest	Post Test	Calculated Percentage
1.)	0	15	75
2.)	3	17	85
3.)	3	17	85
4.)	3	17	85
5.)	3	19	95
6.)	3	16	80
7.)	3	16	80
8.)	3	17	85
9.)	3	16	80
10.)	3	16	80
11.)	3	16	80
12.)	3	18	90
13.)	3	17	85
14.)	3	16	80
15.)	3	17	85
16.)	3	17	85
17.)	3	16	80
18.)	3	17	85
19.)	3	16	80
20.)	3	16	80
21.)	3	14	70
22.)	2	15	75
23.)	2	18	90
24.)	2	17	85
25.)	2	16	80
26.)	2	17	85
27.)	2	17	85
28.)	2	16	80
29.)	2	19	95
30.)	2	17	85
31.)	2	17	85
32.)	2	17	85
33.)	2	18	90
34.)	2	15	75
35.)	2	18	90
36.)	2	16	80
37.)	2	16	80
38.)	2	16	80
39.)	2	17	85
40.)	2	17	85
41.)	2	17	85
42.)	2	16	80
43.)	2	16	80
44.)	2	17	85
45.)	2	16	80
46.)	1	15	75
47.)	1	16	80
48.)	1	17	85
49.)	1	16	80
50.)	1	17	85
51.)	1	17	85
52.)	1	17	85
53.)	1	17	85
54.)	1	16	80
55.)	1	17	85
56.)	1	17	85
57.)	1	17	85
58.)	1	17	85
59.)	1	17	85
60.)	1	17	85
61.)	1	15	75
62.)	1	17	85
63.)	1	16	80
64.)	1	17	85
65.)	1	15	75
66.)	1	17	85
67.)	1	17	85

*Participant's Identification Number.

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